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This volume focuses on the multiple ways in which stone tools can inform archaeologists about the evolution of hominin cognitive abilities. One of the major questions addressed in the volume deals with the appearance of Oldowan, which could be either the result of a dramatic change in cognitive abilities, or the transition to a more archaeologically visible medium. Another question concerns the similarities and differences in cognition that underlie human and non-human primate tool behaviour.

Several research directions are presented here, including PET scans of human knapping, and questions concerning the origins of language and its relation to learning. The hypotheses of the transition of hominin knapping from a common ancestor with cognitive abilities similar to chimpanzees and bonobos is discussed by some authors.

In chapter 2, Mark W. Moore shows that human infants and primates use similar strategies to organize utterances and motor actions. Initially similar, these strategies, called 'grammars of action', evolve into an ontogenetic divergence in children that leads to a separation of complex linguistic and action grammars. This paper develops a model of the essential motor actions of stoneworking interpretable in action grammar terms. It is a new version of typology based

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on an understanding of processes of flake removal. It is comparable to the standard vehicle developed recently by Miriam Haidle (2009) — she terms a 'cognigram' — used to compare the tool use of non-humans and early hominins. From his grammar of actions, Mark W. Moore describes possible stages in the development of stone-knapping complexity among early hominins. However, the author notes that stone tool manufacture did not necessarily reflect maximum abilities of human and perhaps hominin ancestors. Indeed cognitively modern *Homo sapiens* sometimes knapped stones in ways that were very similar to non-modern hominins. Consequently it is necessary to take into account social and/or environmental pressures, and not only cognitive evolution in order to understand increasing complexity in stone tool manufacture.

Ignacio de la Torre (chapter 3) discusses the nature of the early Oldowan, its implications for understanding the cognitive capabilities of the earliest knappers, and its relationships to ape tool use. He argues against the proposition according to which the emergence of stone knapping would originate in percussion activities involved in food processing (especially hammer-and-anvil technique to crack out nuts). For him, evidence of hammer-and-anvil technique displayed by some capuchin monkeys of the New World invalidates such a hypothesis: if we admit that this technical behaviour was present in a common ancestor, we have to admit that the shared hominid ancestor to chimpanzees and capuchins had those technological abilities 30 mya ago. Obviously this is hard to support. Personally, I would suggest that this technique to crack nuts could have been invented independently by some chimpanzees in Africa and some capuchins in the New World. Why did they have to share a common ancestor with this technical aptitude? There is no reason to reject possible convergence. Such a hypothesis does not exclude the possibility that percussion activity could have evolved towards stone tool behaviour in some places. However the gap between nut-cracking activity and stone knapping is more cognitive than technical. The actions of chimpanzees cracking nuts and Oldowan hominids knapping stone tools or producing flakes are not qualitatively different and the control of the speed and the strength of the action is equally important for a positive result in the two cases. However, producing a conchoidal fracture presupposes the choice of an area of impact on the basis of the mass and shape of the block and requires precision in the strength and direction of the blow. Indeed, the actions are virtually the same but the mental processes differ: mental images of the aimed object are required. So we have to look for the explanation for the qualitative jump between the two types of percussion in modifications of cognitive ability and not of the capacity for manual skill.

In chapter 4, April Nowell and Mark White try to understand some of the repetitive patterning in early stone tools. The Acheulian and contemporary technological systems are remarkably static. For them, some of the stasis visible in the archaeological record may be the result of demographic and not necessarily cognitive factors. They also explore how the insertion of a uniquely human childhood stage of growth and development into the typical primate pattern affects learning and sociability. The duration of childhood and adolescence may have been considerably shorter in Middle Pleistocene hominins, who experienced a faster pace of development than modern humans. A short childhood in small groups with limited peers with whom to play, experiment, and learn new tricks, could be retarding true innovation. This hypothesis is coherent with Gilbert Simondon's ideas about early acquisition of technical knowledge by daily and deep impregnation, perhaps characterized by some rigidity due to a lack of thinking, discussing and handing-over in question at adulthood.

Another way to understand the cognitive context of Oldowan knappers is to look for the evidence of forethought, planning and enhanced working memory. Thomas Wynn and Frederick L. Coolidge (chapter 5) compare the Levallois reduction and the *façonnage* strategy of bifaces in terms of long-term working memory. They brilliantly demonstrate that the cognitive demands of biface reduction required fewer procedural subroutines and less working-memory capacity. In its overall organization the retrieval structure deployed by a Levallois knapper was no different from those deployed by modern artisans. The power of expert retrieval structures has evolved over the course of hominin evolution. They argue that Levallois reduction *per se* does not require Theory of Mind and they explore the possibility that *learning* Levallois reduction did.

The depth of intentionality is studied by Steven L. Kuhn (chapter 6) through the identification of standardized tools. I agree with the author when he puts the emphasis on the fact that it is necessary to take into account that some archaeological analyses force the appearance of standardization. Because they are influenced by so many factors, artefact forms may be less informative about technological intention among ancient hominins than are core reduction and raw material exploitation.

Sarah Wurz (chapter 7) questions the wider significance of the characteristics of the European Palaeolithic industries in relation to the Middle Stone Age industries of South Africa. The MSA 1, MSA 11, and Howiesons Poort from Klasies River Mouth are discussed in the context of symbolic behaviour and its palaeoanthropological and archaeological indicators. Like Steven L. Kuhn, Sarah Wurz brings into relief the difficulty for analysts to separate out those components of stone tools that may indicate style and convention, from which symbolic representation can then be inferred.

Dietrich Stout (chapter 8) explores the possible evolutionary relations between complex tool use and language. Three possible types of coevolutionary interactions are currently proposed: interactions involving shared neural substrates (hierarchical combination in the inferior frontal gyrus and action understanding in the cortical mirror-neuron system), shared social context (mental state attribution and joint attention, contribution of language to skill learning and cooperative activity) and shared reliance on general capacities (such as working memory). These three possibilities are not mutually exclusive. To evaluate the actual evolutionary significance of these possible relations, D. Stout undertook functional brain-imaging studies of Lower Palaeolithic tool

making. For him, this study demonstrates an overlap with cortical language circuits consistent with motor hypotheses of speech and language origins. Ethnographic and developmental evidence highlights the role of joint attention and intentional communication in the social reproduction of both stone knapping and language skills.

In chapter 9, Iain Davidson summarizes some previously published works about the comparison of the earliest stone tools with chimpanzee tool making and use. He then wonders about its implications for understanding the evolution of hominin and human cognition. He argues that 'cutting' is one of the key innovations making stone tools part of the hominin adaptation. I agree with him but I want to add a remark about the invention of 'cutting': which is the contribution that most clearly identifies hominization — the conception of tools not found in nature (which is within the reach of chimpanzees) or the steps allowing the resolution of the problem of cutting by the production of cutting edges. It seems that, never having discovered cutting, the apes were unable to master the actions required for cutting, rubbing, grating, and grinding. Why are apes unable to cut? Maybe because the cracking action — known by some apes — supposes a first-degree intention (for instance cracking open nuts), while cutting action supposes an additional degree of complexity beyond their reach. Indeed, cutting action supposes two distinct stages: first, producing cutting edges, second, subsequent use. Davidson opines that the cores and abandoned flakes created a new environment of opportunity. In my opinion, he is here victim of retrospective illusion: a flake with a cutting edge is only useful if one already knows cutting tools. This link is obvious for us but was not for the first hominins.

In the final chapter, Philip Barnard proposes a contribution from the perspective of a behavioural scientist. His understanding of a more complex model of cognition and its evolution allows for the early emergence, among apes and the last common ancestor of apes and humans, of complex spatial-praxis actions. This model predicts that complex vocal utterances and combinations of them emerged earlier among hominins than the reflexive thought generated only from the inputs of mental activity of the agent concerned.

The interest of this book lies in providing a better understanding of the relation between cognitive and technological evolution of the first hominins. Stone tools may well be the best way to get at the really important changes in the evolution of our ancestors. It is appropriate to note that cognitive and archeological studies about the emergence of cognitive human abilities are currently very prolific with at least two major publications in 2009, published by Cambridge University Press and by Wiley-Blackwell.

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